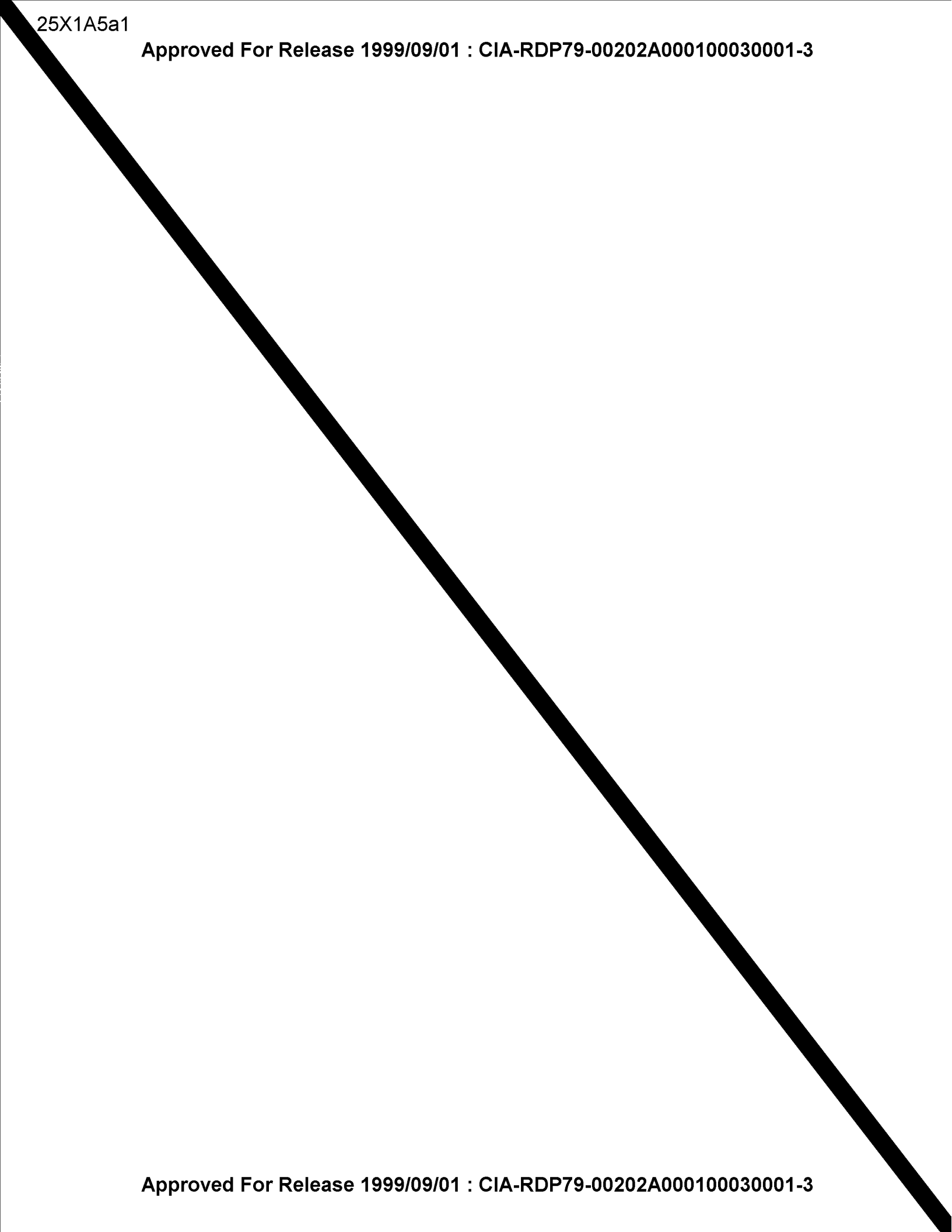

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SUPPLEMENT TO

SOVIET GEODETIC PHOTOGRAMMETRIC

INSTRUMENTATION

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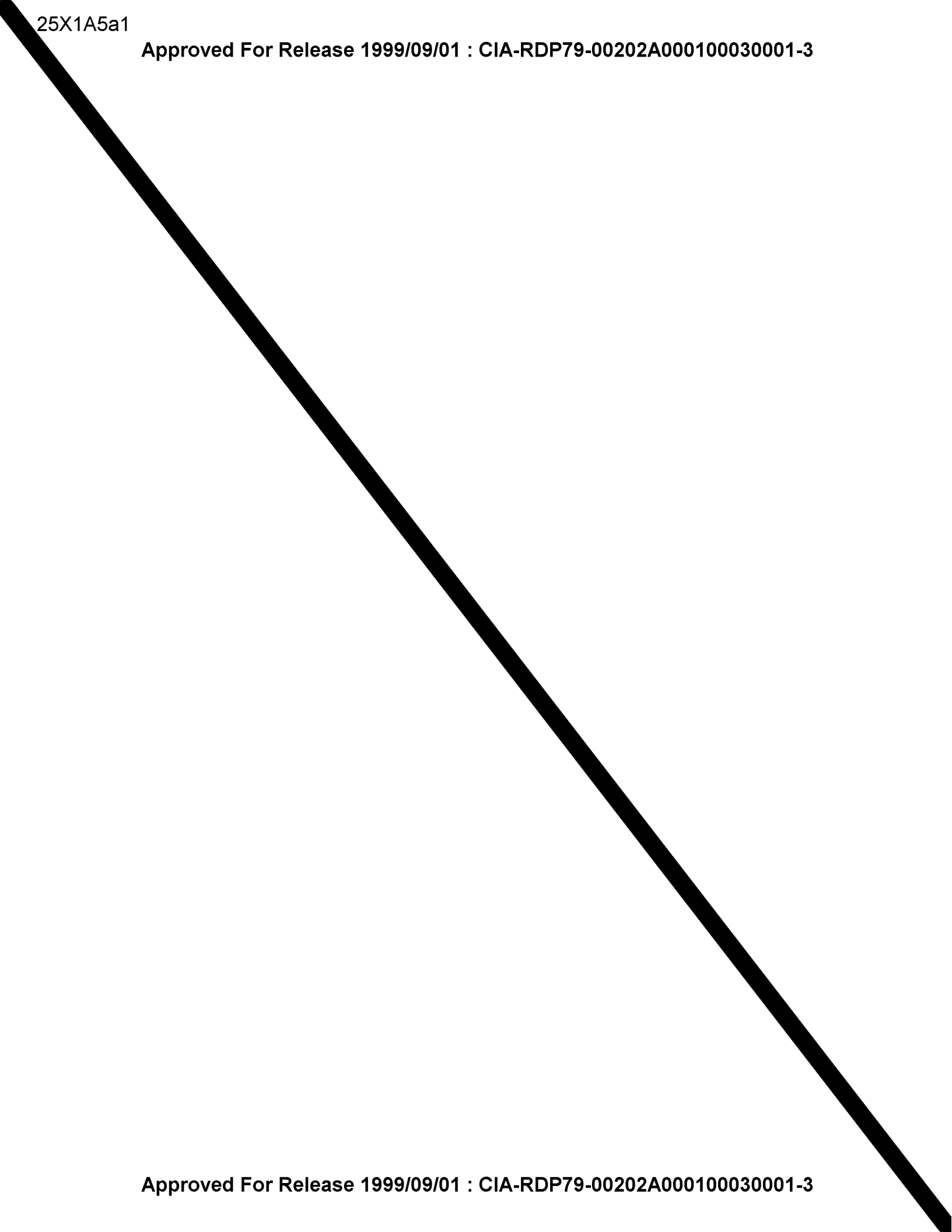

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INTRODUCTION

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25X1A5a1 The following report is submitted as a supplement to [redacted] "Soviet Geodetic and Photogrammetric Instrumentation". This supplement is forwarded for the use of technical personnel in the fields of photogrammetry, geodesy, photography and, to a lesser degree, for technicians working in the field of map reproduction.

The report consists of lists of references where detailed, operational diagrams, photographs, optical systems, etc. of instruments used by the Soviets in the above-mentioned sciences may be found in Soviet scientific literature.

Seven, recent Soviet references were selected as being most significant for the purpose of this report. They are as follows:

I. Mikhaylov, V. Ya., Fotografiya i Aerofotografiya (Photography and Aerial Photography), Izdatel'stvo Geodezicheskoy i Kartograficheskoy Literatury, Moskva, 1952..... 3

II. Drobyshev, F.V., Fotogrammetricheskiye Pribory i Instrumentovedeniye. Moscow, 1951 21

III. Volosov, D.S., Metody rascheta slozhnykh fotograficheskikh sistem. (The Rating Methods of Complicated Photographic Systems). OGIZ 1948 30

IV. Tudorovskiy, A.I., Teoriya Opticheskikh Priborov, (The Theory of Optical Devices). Part II (Part I was checked but did not contain desired instrumental information). Izdatel'stvo Akademii Nauk SSSR. Moskva, Leningrad, 1952 36

Subject: Pictures of Photographic and Photogrammetric Instruments and Designs and Graphs of Operational Characteristics of Main Optical Systems, as Abstracted from Soviet Sources.

Source I: Mikhaylov, V. Ya., Fotografiya i Aerofotografiya (Photography and Aerial Photography), Izdatel'stvo Geodezicheskoy i Kartograficheskoy Literatury, Moskva, 1952.

Reference to Text Description	Figure or Table No.	Page on Which Fig. or Table is Found	Information Available
Page 35, Section 8	Fig. 10-e	Page 21	Detail Drawing of the "Ortogoz" Objective. Camera, "Fotokor" is equipped with this objective; it is an uncemented four-lens anastigmat. Data: Focal Length: 13.5 cm. Relative Aperture: 1:4.5 Field of View: 55°
Pages 35-36	Fig. 10-d	Page 21	Detail Drawing of the "Industar" Objective (of which there are several). This is an unsymmetrical semi-cemented anastigmatic objective. It is manufactured in various focal lengths.
Page 36	-	-	"Industar - 11" Objective (No picture). Used in reproduction cameras. These objectives are manufactured with focal lengths: 21, 30, 60, 90, and 120 cm. Relative Apertures: 1:4.5 for small cameras 1:9 for large cameras

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 36	-	-	"Industar-22" Objective. (No picture). Data: Focal Length: 50 mm. Relative Aperture: 1:3.5 Field of View: 46° Resolving Power, in Center of Field: 40 lines; Resolving Power, at Edge: 20 lines. Used in cameras, "FED" and "Zorkiy".
Page 37	-	-	"Industar-23" Objective (No picture). Data: Focal Length: 110 mm. Relative Aperture: 1:4.5 Field of View (Diagonally): 52° Used in camera, "Moskva II"
Page 37	Fig. 21	Page 36	Detail Drawings of External View and Diagrams of Internal Arrangement of Lenses of "Yupiter" Objectives for "Kiyev" Photoapparatus. (Camera)
Page 37	Fig. 21-1	Page 36	"Yupiter 3" Objective. Data: Focal Length: 50 mm. Field of View: ≈ 45° Relative Aperture: 1:1.5

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
	Fig. 21-2	Page 36	"Yupiter-8" Objective. Data: Relative Aperture: 1:2 Field of View: 45°
	Fig. 21-3	Page 36	"Yupiter-9" Objective. Data: Focal Length: 85 mm. Relative Aperture: 1:2 Field of View: 28°
	Fig. 21-4	Page 36	"Yupiter-11" Objective. Data: Focal Length: 135 mm. Relative Aperture: 1:4 Field of View: ≈ 13.5°
	Fig. 21-5	Page 36	"Yupiter-12" Objective. (A wide-angle anastigmatic objective with field of view of 63°) Data: Focal Length: 35 mm. Relative Aperture: 1:2.8
Page 37	Fig. 22	Page 37	Detail Drawings of External View of Objectives for "FED" Cameras.
	Fig. 22-b	Page 37	Universal ("Universal'nyy") Objective for "FED". Data: Focal Length: 50 mm. Relative Aperture: 1:3.5 Field of View: 55°

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 37	Fig. 22-v	Page 37	High Light Power ("Svetosil'nyy") Objective. Data: Relative Aperture: 1:2 Remaining Characteristics: Same as for the Universal Objective (above).
Page 37	Fig. 22-a	Page 37	Wide-angle ("Shirokougol'nyy") Objective. Data: Focal Length: 28 mm. Relative Aperture: 1:4.5 Field of View: 76°
Page 37	Fig. 22-d	Page 37	Teleobjective ("Teleob"yektiv"). Data: Focal Length: 100 mm. Relative Aperture: 1:6.8 Field of View: 24°
Page 38	Fig. 22-g.	Page 37	Reproduction ("Reproduktsionnyy") Objective. This objective "has the same characteristics as the Universal Objective, but the objective's mounting is made in the form of two pipes, moving one in the other, which makes it possible to move the objective rather far out from the light sensitive coating and make an exposure from a distance of 15 cm., increasing by this means the scale of the representation up to 1:2, which it is not possible to do with the ordinary "FED" objective."

Reference to Test Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 38	Fig. 23	Page 38	Diagrams of Internal Arrangement of Lenses of Aerial Surveying Wide-angle Objectives. Note: No further data is given.
-	Fig. 23-a	Page 38	"Russar-19" Objective.
-	Fig. 23-b	Page 38	"Russar-25" Objective.
-	Fig. 23-v	Page 38	"Russar-29" Objective.
-	Fig. 23 g	Page 38	"Rodina-2" Objective.
-	Fig. 23-d	Page 38	"Russar-31" Objective.
Page 38	Fig. 24	Page 39	Design of Mirror-Lens Objectives. 1. Meniscus, 2. Mirror, 3. Concave Mirror, 4. Focal Plane.
Page 38	Fig. 25	Page 39	Pictures (External View) of Various Types of Objective Mounts.
Page 38	Fig. 25-a	Page 39	"'Industars', used for reproduction, have the so-called normal mount which is located entirely outside of the camera. ("Normal'-naya oprava").
Page 38	Fig. 25-b	Page 39	Sunken ("Uglublennaya") Mount. For portable and miniature cameras, in which the mount only partly extends outside.
Page 38	Fig. 25-v	Page 39	Sunken with Shutter ("Uglublennaya s zatvorom") Mount.

Reference to Test Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 38	Fig. 25-g	Page 39	Worm-screw ("Chervyachnaya") Mount. Used in those cases where the focusing is done by moving the objective along the optical axis.
Page 49	Fig. 40	Page 49	Pictures (External View) of the "AFA-33" Series of ("Aerofotoapparat") Aerial-Photo-Apparatuses = Cameras and Attachments. These apparatuses are "with cones for objectives with various focal lengths. In the case of very short-focus apparatuses the cone is lacking. The objectives have a between-the-lens shutter, the threshold speed of which rarely exceeds 1:120 sec. Curtain-slot shutters for apparatuses, intended for precision operations, are used rarely, in view of the distortions produced by them." The apparatuses of this series shown in Fig. 40 include the following: "AFA-33/100," "AFA-33/75", "AFA-33/50," "AFA-33/20." The labelled parts indicated are as follows: 1. camera section; 2. cone; 3. cassette; 4. electric power unit; 5. control

Reference to Test Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
			device; 6. electric cord; 7. light filter; 8. mounting; 9. Cardan roller; 10. flexible rod.
Pages 50-51	Figure 41	Page 50	Detail Drawing of the Kinematic System of an Aerial-Photo-Apparatus (Camera and Auxiliary Parts). Parts are labelled, No. 4 is a "Zhalyuzi" ("Jalousie") Shutter.
Page 52.	Fig. 42	Page 51	Design of a Slit ("Shchelevoy") Aerial-Photo-Apparatus. (Labelled Parts: 1. "Russar" F - 70. 2. "Plazmat" F - 210.
Page 83	Fig. 56	Page 83	Design of Golberg's ("Gol'dberga") Densograph ("Denzograf"). Labelled Parts.
Pages 83-84	Fig. 57	Page 84	Detail Drawing of Densitometer of GOI. Labelled Parts.
Page 85	Fig. 58	Page 84	Detail Drawing of Polarized Martens Densitometer.
Pages 85-86	Fig. 59	Page 86	Detail Drawing of Sensitometer of GOI. Parts are labelled in both Fig. 58 and Fig. 59.
Page 87	Fig. 60	Page 87	Detail Drawing: A Developing Device (Not named).
Page 87	Fig. 61	Page 88	A Sensitometric Graph (GOST-2817-45, Soviet Russian System of Sensitometry). (Note: This system, GOST-2817-45, is described on pages 85-91.).

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
Page 87	Fig. 62	Page 88	Characteristic Set of Curves (GOST-2817-45, Soviet-Russian System of Sensitometry).
Page 89	Fig. 63	Page 89	Characteristic Curve, (GOST-2817-45, Soviet-Russian System of Sensitometry).
Page 91	Fig. 64	Page 91	Determination of the Value γ of the Coefficient of Contrast.
	Fig. 65	Page 92	Connection Between ΔD, γ and U.
	Table 11	Page 93	Values of Recommended Coefficient of Contrast for Different Types of Photographic Materials.
	Fig. 66	Page 92	Curve of Dependence of S, D_o and γ on the Time of Developing (Development Time).
	Fig. 67	Page 94	Juxtaposition of Luminosity Intervals and Photographic Width.
	Fig. 68	Page 96	Different Methods of Indicating Sensitivity.
	Fig. 69	Page 96	Sensitivity's Dependence Upon the Form of the Characteristic Curve.
	Table (No number)	Page 98	Table of Sensitivity Issued by the Main Directorate of the Motion Picture Film Industry.
	Fig. 70	Page 99	Sensitometric Parameters of Photographic Paper.
	Fig. 71	Page 100	Test Object for Paper Examination.

Reference to Text Description	Figure or Table No.	Page on which Fig. or Table is Found	Information Available
	Fig. 72	Page 101	Spectrograph.
	Fig. 73	Page 102	Spectrograms of an Orthochromatic Film.
	Fig. 74	Page 102	Spectrosensitometer.
	Fig. 75	Page 103	Curves of Spectral Sensitivity of Different Sensitive Materials.
	Fig. 76	Page 104	Color Table.
	Fig. 77	Page 104	Color Table.
	Fig. 78	Page 106	Curve of Filtration through the Light Filter.
	Fig. 79	Page 107	Different Types of Light Filters (Diagram).
	Fig. 80	Page 107	Spectral Characteristics of Some Light Filters (Diagram).
	Fig. 81	Page 109	Elements of Spectral Curve of Light Filters and Table 12.
	--	Page 110	Table 13. Filtration Power of Different Light Filters.
	Fig. 82	Page 111	Relation of Different Sensitive Emulsions to the Rays of Various Wave Lengths.
	--	Page 111	Table 14. Absorption Power ("Kratnost'") of Aerial Survey Light Filters for Films.
	--	Page 112	Table 15. Absorption Power of Light Filters of Films for Land Survey.

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Page No.	Figure No.	Information Available
178	109	Design of a Device for Determination of Light Dispersion.
181	--	Table 35. Coefficients of Losses K_o and K_β and K_3 for Cameras AFA-13, with "Industar-13" Objective, AFA-I with "Industar-51" Objective, RMK with "Russar-25" Objective, and K-17-B, with "Metrogon" Objective.
183	--	Table 36: Values of a Coefficient of Light Dispersion for 7 Different Cameras: 1) "Fotokor", Objective - "Ortogoz" f = 135 mm; 2)"FED", Objective with f = 50 mm. (Not named); 3) "Elmar", Unnamed Objective with f = 35 mm.; 4) "Road Camera", with "Russar-19" Objective, and Lens Shade ("Ottenitel'"); 5) The Same without Lens Shade; 6) AFA-98, Objective - "Russar-1" and Lens Shade; 7) AFA-98, without Lens Shade.
184	110	Influence of Light Dispersion on the Characteristic Curve.
186	111	Resolving Power of Photographic Material for Test Object with a Changeable Contrast.
186	112	Influence of Location of Density of Image on the Characteristic Curve for the Resolving Power of a Sensitive Coating.
187	113	Connection Between Resolving Power and Contrast Range of the Test Object.
190	114	Dependence (Interdependence) Between Admissible Displacement of Image and Scale of the Aerial Photograph.
192	115	Photo-electric Aerial Exposure Meter. (Picture of External View).
193	116	Substance of Nomographic Method for Calculation of Luminosity.

Page No.	Figure No.	Information Available
194	117	Front and Back Views of the AEN-IV Exponometer.
197	118	Change of the Optical Mass of the Atmosphere in a Perspective (Oblique) Survey.
200	--	Table 37. Exposures for Photographing Submerged Objects.
201	119	Spectral Coefficient of Brightness for Deciduous and Coniferous Forests.
202	120 a and b	Aerial Photographs in Visible and Infrared Zones of the Spectrum.
203	121	Location of Light Source in Night Aerial Photography.
204	122	Sensitometric Curves of Aerial Films with Different Photographic Width for Night Aerial Surveying. (Chapter 7: Reproduction Photography).
224	126	Field Set-up for Photographing of a Mosaic.
225	127	Small Reproduction Camera (Diagram) (Not named).
225	128	Picture of External View of Reproduction Camera of "Bol'shevik" Factory.
226	129	Picture: Wooden Reproduction Camera, (Not named).
226	130	Picture: Two-chamber Camera, (Not named).
227	131	Picture: Vertical Reproduction Camera (Not named).
228	132	Picture: Universal Photostat Apparatus (Not named).
228	133	Inversion of Images (Diagram).
230	--	Table 41. Relation of Blue, Green and Red Rays.
232	--	Table 42. Minimum Assortment of Polygraphic Films.
233	134	Spraying Table for Plates, (Diagram).

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236	136	A Grating (or Screen) (Diagram).
		(Chapter 8: Theory and Practice of the Negative Process).
243	137	Successive Phases of Crystal Development.
243	138	Developed Crystal of Haloid Silver Enlarged 30,000 times.
244	139	Photolysis of Silver Bromide.
246	140	Design Showing Process of AgBr Restoration.
247	141	Microcuts Through the Developed Coating in the Process of Developing.
247	142	Scheme of Development of Emulsion Coating.
252	143	Solubility of Silver Bromide in Solutions of Sulfite.
257	144	Displacement of the Characteristic Curve Under the Influence of Potassium Bromide. (Graph).
265	145	Developing Device with Crimps (Diagram).
266	146	Picture of External View of Spiral Developing Device (Spiral and Winding Stand).
266	147	Diagram of Conical Spiral.
266	148	Diagram of Spiral Device with Rods.
267	149	Diagram of External View of Developing Device with Rewinding of Films.
268	150	Diagram of External View of Developing Device, Automatic.
269	151	Lines of Equal Density of the Negative, Developed in a Cuvette.
269	152	Forming of Strips under the Dark Parts of the Negative.
270	153	Graph: Mikhaylov's Nomogram.

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274	154	Graph: Influence of Benzo-triasole.
275	155	Scheme of Developing Process with Conversion.
276	156	Graph: Influence of Size of Crystals of Silver Haloid on Fixing Speed.
277	157	Comparative Speed of Fixing of Negative and Positive Emulsions.
280	158	Electrolytic Bath of NIKFI.
281	159	Influence of Speed of a Water Flow on Completeness of Washing.
282	160	Influence of Salting on Speed of Film and Print-washing.
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284	162	Change of Residual Quantity of Thiosulfate in Paper During Washing.
285	163	Diagram or Detail Drawing of Drying Drum.
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289	166	Design of Field Densitometer.
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303	170	Correlation Between lg Bo and lg Bpos.
304	171	Connection Between Δlg Bo, ΔDneg. and ΔDpos.
306	172	Graphical Method for Construction of the Curve of Reproduction.
308	173	Construction of a Curve of Reproduction for a Particular Case.
308	174	Connection Between Δ D and L.

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310	175	Determination of Maximum Time for Developing.
311	176	Pneumatic Copying Frame, Picture of External View.
312	177	Design of Copying Device.
313	178	Three Different Types of Printing Machines, Pictures of External Views.
317	179	Different Types of Illuminators, Diagrams.
320	180	Diagram: A Diminisher.
323	181	Diagram: A Washer for Paper.
324	182	Drawing of External View of a Drier for Paper.
324	183	Picture of External View of a Glossing Device.
330	184	Diagram: Developing of Diazo-paper by Ammonia.
332	185	Diagram: Transferring by the Ozobrom (?) ("Ozobromnyy") Process.
		(Chapter 10: Basis of Color Photography).
335	186	Spectral Sensitivity of Color Perceptible Elements of the Eye.
336	187	A Color Triangle.
337	188 a, and b.	Additive and Subtractive Synthesis of a Color.
339	189	Scheme of Subtractive Process.
340	190	A Color-dividing Camera.
342	191	Diagram: Scheme of Construction of a Multi-coated Film and Paper.
344	192	Characteristic Curves of Colored Films.
346	193	Curves of Filters Used in Colored Photographing.
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348	195	Scheme for Obtaining of Colored Image on Three-Coated Films with Conversion and Simultaneous Colored Developing.
349	--	Table 44. Processing of 3-coated photographic Materials.
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352	196	Influence of Different Conditions of Processing on γ and D.
355	197	Device for Lighting of Reversible Aerial Film, Picture of External View.
356	--	Table 46: Maximum of Spectral Curve.
359	198	Diagram and Picture of External View of a Multiplicator.
360	199 a and b	Lighting Block of Colored Copying Device. Exterior View of the Copying Device.
361	200	Device for Processing of Paper Prints.
		PRESCRIPTIONS.
364-369	--	Formulas and Components of Solutions.

Source II. Drobyshev, F.V.: Fotogrammetricheskiye Pribory i Instrumentovedeniye. Moscow, 1951

Section 3: Optical Systems in Photogrammetric Devices

Page	Figure	
26	13	Projection Objectives. Detail Drawing: "Ortoniar" f = 100 mm. "Dagor" 1:6,8 f = 180 mm. "Tessar" 1:4,5 f = 200 mm.
26	14	Objectives and Lenses of Sighting ("Vizirnykh") Systems.
32	26	Detail Drawing of "Optical system for obtaining Luminous Mark in Stereoplanigraf SPB".
		Section 4: Rectifying Devices.
46	33	Design of Autocollimator (Avtokollimator)
47	34	Detail Drawing of Goniometer ("Goniometr")
		Section 6: Devices for Photo-rectification.
60	39	System of Photo-rectifier S_2 O ("Fototransformator")
61	40	System of Photo-rectifier S_2 m ("Fototransformator") S_2 m
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70	43	Detail Drawing: "Part of Negative's Carriage of Photo-rectifier (Fototransformator) FTM".
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73	45	Detail Drawing: "Rombic Inverter" ("Rombicheskiy Inversor")
74	46	Detail Drawing: "Angular Inverter".
74	47	Detail Drawing: "Angular Inverter", having Form of a Ruler in Photo-rectifiers of Broken Design.

Source III. Volosov, D.S., Metody rascheta slozhnykh fotograficheskikh sistem. (The Rating Methods of Complicated Photographic Systems). OGIZ 1948.

Chapter 2: Method of Classing Coefficients of Aberration of the Third Order in Symmetrical and Quasi-symmetrical Photographic Systems which Contain Components of Finite Thickness.

Page	Figure	
		Paragraph 1: Two Types of Plane-anastigmats (Objectives)
52	7	Combination of Type X_A
52	8	Combination of Type X_B
		Paragraph 4: Computation Investigations (Note: Figures 9-11 Computation Graphs)
69	12	Optical Design of 4-Lens Objective "Ortagoz".
69	13	Optical Design of Three-Lens Objective with Compensator for Astigmatism and Curved Field.
		(Note: Figures 14-15: Graphs of Computation Curves for Optical Systems).
		Chapter 4. Analysis of Several Present-Day Types of Complex Anastigmatic Objectives.
		Paragraph 3. Light-Powerful (of great light-gathering power) of the "Planar" type.
92	16	Optical Design of Several Anastigmats (Anastigmatic Objectives) Variation of "Planar".
92	16 a	Drawings showing Optical Design of a variation of the "Planar" anastigmatic Objective shown in Figure 1-b of this text. The variation consists of two-lens cemented components in place of the outer lens shown in figure 1-b. It is said that the possibilities of variations (field of possible resolvings) of systems of the type of Fig. 16-a are extremely varied.
	16 b	Drawing of optical Design of Merté System (a Variation of the "Planar" Anastigmat)
	16 c ("v")	Drawing showing Optical Design of Another Variation of the "Planar" Anastigmatic Objective.

Page	Figure	
164	24_e	Drawing of Volosov Objective, a five-lens anastigmatic objective. "Sometime later (in 1937 - 1938) the author of these lines also undertook an investigation of this rather unusual design of Taylor, at the same time trying to simplify it, in particular, investigating the resolving for a five-lens design of an anastigmat".
166	25	Optical Design of the "Montar" Objective (German System). (Omitting here the exposition of the results obtained (extremely interesting), we shall point out only that a comparative and fuller evaluation of them (anastigmats) will be possible only later, when the construction of the foreign long-focus complex anastigmats will have become known and, in particular, the German Systems of the type "Zonar" and "Montar" (Fig. 17-a and 25) and the American systems of the type "Aero-Ektar" (Fig. 38)."
183	26_a 26_b	Diagrams of "Dispersion, Formed by Rays of Oblique Pencils..." etc.
187	27	"Graph of Aberration of Broad Pencils of Rays."
		Part 2: Method of Computing Photographic Systems with Variable Optical Characteristics
189	28	Drawing: Warmisham System. (Fr. pat. specif. 398, 807).
		Paragraph 1. The Area Paraxial Optics.
196 230	29 31	Diagrams: Geometrical Interpretation of Junctions; etc.
234	32	Drawing: Optical Design of System of "Idar." (Objective)

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Source IV. Tudorovskiy, A.I., Teoriya Opticheskikh Priborov, (The Theory of Optical Devices). Part II (Part I was checked but did not contain desired instrumental information). Izdatel'stvo Akademii Nauk SSSR. Moskva, Leningrad, 1952. DLC: QC 355.T832 (P 694, MF #278-A).

Chapter 16. The Photographic Objective

Page	Figure	Information Available
106	305	Drawing: Design of "Tessar" Type Objective with Focal Length - 174.74 and Relative Aperture 1:4.5.
133	320	Picture of "Universal Device" (for testing objectives and with special attachments for application of the J. Hartmann Method) of the "Askaniya" Firm.
173	331	Picture: Four Interferograms of "Tvayman" Obtained With a "Tessar" Objective (Focal Length = 210 mm., Relative Aperture 1:4.5).

Section 228. Survey of the Main Types of Photographic Objectives.

177	332	Drawing: Design of the "Petsval" Objective. Built in 1840 using Petsval's computations. The first "powerful in light-gathering" objective. Data: $f/3.5$, 2β = 20-30°.
177	333	Drawing: Design of Symmetrical Objective of A. Shteyngeyl' (1865). Consists of 2 meniscuses with a diaphragm between them.
177	334	Drawing: Design of "Hypergon" Objective. This is a wide-angle objective manufactured by the firm of Hertz ("Gerts"). The designer, in 1900, was "Gyëyeg." (This is said to be "the first orthoscopic wide-angle objective").
178	335	Drawing: Design of "Aplanat" Objective. This represents "a perfectly natural transition from the symmetrical design

Page	Figure	
		type which could not be corrected for astigmatism. The double objective has a relative aperture of 1:5.8 and a field of view of about 60° with full aperture. This objective enjoyed great popularity and retained its significance until recently (up to the time when the Hertz firm shut down); "in the first decade of the 20th Century, it was manufactured in Russia, in Warsaw, by the 'Fos' firm, which had received the right to produce it under another name: 'Planastigmat Fos'".
180	339	Drawing: Design of a Double Anastigmat, Composed of Two Unidentical "Protar" Lenses. (As for the "Protar" - "there exist a large number of symmetrical anastigmats, consisting of two halves, of which each is cemented out of more than three lenses").
181	340	Drawing: Design of the "Planar" of K. Zeiss, computed in 1896 by Rudol'f, which may be considered as the first representative of the second group of symmetrical uncemented anastigmats.
181	341	Drawing: Design of the "Tselor" Objective of the Hertz Firm, worked out by Gyëyeg in 1898. This is said to be a simpler design of the symmetrical anastigmats and that type are said to be very great in number.
Section 229.		Objectives with a Large Field of View. (Wide-angle Objectives).
(Note: See also the "Hypergon", Fig. 334 on Page 177).		
183	342	Drawing. Design of the Zeiss "Topogon". This is a development and perfection of the orthoscopic wide-angle objective.

Page	Figure	
		This objective has the following characteristics: $f/6.3$, $2\beta = 90^\circ$, Focal Length: 150 mm.
183	343	Drawing: Design of "Liar-6" Wide-angle Objective, an M. M. Rusinov Objective. Data: Focal Length 100 mm., $f/5.4$ and $2\beta = 104^\circ$.
183	344	Drawing: Design of "Russar-25" (a M. M. Rusinov Objective). Characteristics: Focal Length 100 mm., $f/6.3$, $2\beta = 110^\circ$.
183	345	Drawing: Design of "Express" of Ross (a Wide-angle Objective, which, in Addition to "Ortometar" of Merté (K. Zeiss) of Almost Identical Construction, Has a Significant (Rather High) Light Gathering Power and a Good Correction of Distortion. Data: $f/4.5$, $2\beta = 70^\circ$.

(Note: On page 183, it is stated: "There are a small group of wide-angle objectives in which distortion not only is not corrected, but, on the contrary, occurs up to very great values with the aim of significantly diminishing the angle between the main rays and the axis after their emergence from the center of the outlet pupil in comparison with those same angles in space of objects".).

183	346	Drawing: Design of the Hill ("Gill") Objective. Data $f/22$, $2\beta = 180^\circ$.
184	347	Drawing: Design of the Schulz ("Shul'ts") Objective. Data: Focal Length 35 mm., $f/5.6$, $2\beta = 135^\circ$.
184	348	Drawing: Design of the "Pleon" Objective. Data: Focal Length 72.5 mm., $f/8$, $2\beta = 130^\circ$. (Six lenses and plane-parallel plate of colored glass).

Section 230. "Powerful in Light-gathering" ("Svetosil'nyye") Objectives.

Note: The first of these objectives was the very old "Petsval " objective. See Figure 332, page 177 of this volume.

Page	Figure	
185	349	Drawing: Design of the "Biotar" Objective. "In 1911 Rohr increased the relative aperture of the "Petsval" Objective to $f/2$ by the addition of a negative lens, placed almost in the focal plane in front of the light-sensitive coating, as can be seen from the design of the objective in Figure 349; this objective, called "Biotar", had no practical value; its 2β did not exceed 20°".
185	350	Drawing: Design of the "Ernostar" Objective. "In 1924 the Erneman firm produced the "Ernostar" Objective, computed by Bertele with $f/1.8$, of relatively complex design, as can be seen in Figure 350; 2β = about 35-40°. The objective occupied a well-known place on the market: the "Ermanoks" camera with this objective for night exposures was produced by the firm of Zeiss-Ikon."
185	351	Drawing: Design of the G. G. Slyusarev Objective. "In 1922 such an objective was computed by G. G. Slyusarev; one experimental model was prepared with a good result. Objectives which were very close to this design were produced in Europe and America some time later under the name "Takhar". In 1933 the objective of G. G. Slyusarev, which preserved the type, was perfected, while its 2β was brought to 45-50°; the design of this objective is given in Figure 351".
185	352	Drawing: Design of the "Kinoplasmat" of Rudol'f. "The symmetrical designs were adapted for computation of the "powerful in light-gathering" objectives by various firms. Thus,

Page	Figure	
		for example, "Kinoplasmat" of Rudol'f, of the Hugo Mayer Firm has a design, represented in Figure 352; Data: $f/2$."
185	353	Drawing. Design of "Biotar" Objective. "In 1927 the K. Zeiss Firm produced a "powerful in light-gathering" objective under the former name "Biotar", computed by Merte, with $f/1.4$ and small 2β - not more than 30°. As can be seen in Figure 353, the design of this objective is very complex."
186	354	Drawing: Design of one of the Variants of the Compound Anastigmat "Uran" Type (D. S. Volosov). Data: Focal Length - from 25-500 mm., $f/2$ to $f/3.5$ and 2β from 40-63°.
186	355	Drawing: Design of the "Aeroektar" Objective of the "Kodak" Firm. Data: Focal Length 175 mm., Relative Aperture $f/2.5$ and $2\beta = 50°$.
186	356	Drawing: Design of a Variant of "Ektar" Objective of "Kodak" Firm. Data: $f/1.5$.
186	357	Drawing: Design of the "Zonnar" Type Objective of the K. Zeiss-Ikon Firm. Data: Focal Length 50 mm., $f/1.5$ and 2β 46°. Note: These are made also with $f/1.4$ to $f/2$ and $f/2.8$.
187	358	Drawing: Design of a "Mirror-Lens Objective, Computed by D. S. Volosov, D. Yu. Gal'pern and Sh. Ya. Pechatnikova." Data: $f/1.4$, $2\beta = 15°$.
187	359	Drawing: Design of One of the "New Mirror-Lens Objectives Considered in an Article by J. Flügge...of the Bush Firm" Designer: "Veydert"). Data: Nominal $f/0.9$, Equivalent (Effective) Aperture $f/1:1.15$ and 2β = about 34°.

Section 231. Teleobjectives.

Page	Figure	
188	361	Drawing: "Design of Teleobjective of Bush 'Bistellar'." Data: $f/7$, 2β = about 30°, Focal Distance 1:2.
188	362	Drawing: "Design of the 'Magnar' Objective of the K. Zeiss Firm." Data: $f/10$, 2β = not above 15°, Focal Distance 1:4.
189	363	Drawing: "Design of the 'Teletessar' of the Zeiss Firm." Data: $f/6.3$, 2β = about 35-40°.
189	364	Drawing: "Design of the 'Telekon' Teleobjective of the K. Zeiss Firm." Data: $f/6.3$, Focal Length 1:2.44, Distortion does not exceed 0.2%, and 2β reaches 30°.
189	365	Drawing: "Design of Long-focus Teleobjective of the Bausch and Lomb Firm." Data: Focal Length = 1000 mm., $f/8$.
189	366	Drawing: "Design of Long-focus Teleobjective of the Bausch and Lomb Firm." Data: Focal Length = 1000 mm., $f/5.6$.

Section 233. Objectives for Aerial Photography

Note: There are no "pictures" or "diagrams" or "drawings" of objectives in this section but the following statement is made:

193 "Of the objectives mentioned earlier the following are used for geodetic operations: 'Tessar' with focal length = 250 mm. and $f/4.5$; 'Dagor' (f' = 150, $f/6.8$, 2β about 68°); 'Ortometar' (f' = 135, $f/4.5$, 2β up to 70°); Koss 'Ekspress' (f' = 150 and 200 mm., $f/4$, 2β up to 80°). The use of wide-angle objectives for geodetic purposes provides great economic savings (profits), since it makes possible decreasing the number of pictures necessary to obtain a map of a given section of a locality; therefore, for this purpose the following are used: 'Metrogon', very near to the 'Topogon', and the wide-angle objectives of M.M. Rusinov of the 'Russar" Typ

Source V. Katalog - Spravochnik Laboratornykh Priborov i Oborudovaniya. Vypusk 34. Mashgiz, 1949

Geodezicheskiye i Fotogrammetricheskiye Pribory.

Pages

5-8 Stereoplanigraph ("Stereoplanigraf"). Manufacturer: Armaments Ministry of USSR Plant ("Zavod Ministerstva Vooruzheniya SSSR") Text: Pages 5-8.

5 "Stereoplanigraf" - Picture of Apparatus.

6 "Stereoplanigraf" - Lateral View, Labelled Parts.

7 "Stereoplanigraf" - Detail Drawing of Working Parts.

7 "Stereoplanigraf" - Detail Drawing of Prisms, Numbered.

8 "Stereoplanigraf" - Technical Data.

9-10 Large Photo-rectifier FTB. Manufacturer: Armaments Ministry of USSR Plant. (Bol'shoy Fototransformator FTB)

9 Picture of above.

10 Technical Data.

11-13 Stereocomparator SK 18 x 18. Manufacturer: Armaments Ministry of USSR Plant. (Stereokomparator SK 18 x 18)

11 Picture of External View, Labelled Parts.

12 Detail Drawing of Working Parts.

13 Technical Data.

14-17 Precision Stereometer SM -3. Manufacturer: Armaments Ministry of USSR Plant. (Pretsizionnyy Stereometr SM - 3).

14 Picture of External View, Labelled Parts.

15 Detail Picture, Labelled Parts.

17 Technical Data.

Pages

Pages

60-61 Optical Mining Transit. ("Uglomer Opticheskiy"). Manufacturer: Plant of the Ministry of the Coal Industry of the USSR.

60 Picture (External View). Drawings: Working Parts of this Mining Transit.

61 Technical Data.

62-63 Auxiliary Equipment with Mining Transit KU. "Komplekt Uglomera KU". Manufacturer: Plant of the Ministry of Coal Industry of the USSR.

62 Picture (External View) with Labelled Parts.

63 Picture: Labelled Parts. Technical Data.

64-65 Solar Shadow Course Indicator STU-L-5. ("Solnechnyy Tenevoy Ukazatel' Kursa STU-L5"). Manufacturer: Plant of the Main Administration of Geodesy and Cartography.

64 Picture: External View with Labelled Parts.

65 Technical Data.

66 Block Plumb Bob BO-1. ("Blochnyy Otves BO-1"). Manufacturer: Plant of the Ministry of the Coal Industry of the USSR.

66 Picture (External View) with Labelled Parts. Technical Data.

67 Mirror Optical Square (T-square) ("Ekker Zerkal'nyy EG-1") Manufacturer: Plant of the Armaments Ministry of the USSR.

67 Picture (External View) Technical Data.

68-70 Precision Dumpy Level NPG. ("Nivelir Pretsizionnyy Glukhoy NPG"). Plant of the Main Administration of Geodesy and Cartography.

68 Picture of External View, Labelled Parts.

69 Drawings of Details. Labelled Parts.

70 Technical Data.

71-72 Precision Level HA-1. ("Nivelir Pretsizionnyy NA-1"). Manufacturer: Plant of the Armaments Ministry of the USSR.

Source VI. 20th Anniversary of Soviet Geodesy and Cartography, 1919-1939. (Dvadtsat' Let Sovetskoy Geodezii i Kartografii, 1919-1939.)

Geodetic Instruments.

Pages	Figures	
108	1	Topographical Stereoscope for the Reciprocal Orientation. "Tors". ("Topograficheskiy Stereoskop dlya Opredeleniya Elementov Vzaimnogo Orientirovaniya, Tors").
108	1	Picture of External View.
109	2	Aerial Surveying Stereocomparator. ("Aeros'emochnyy Stereoskop")
109	2	Picture of External View.
111	3	Topographical Stereometer "STD-1". ("Topograficheskiy Stereometr STD-1")
111	3	Picture of External View.
112	4	Topographical Stereometer "TSD-3". ("Topograficheskiy Stereoskop TSD-3")
112	4	Picture of External View.
113	5	Stereoscope "Cyclope". ("Stereoskop Tsiclop").
113	5	Picture of External View.
114	6	Precision Stereometer "SM-3". ("Pretsizionnyy Stereometr SM-3").
114	6	Picture of External View.
115	7	Drawing Device. ("Risoval'nyy Pribor").
115	7	Picture of External View.
190	2	Universal Theodolite of 5" Accuracy. ("Universal 5" Tochnosti").

Pages	Figures	
190	2	Picture of External View.
192	3	Triangulation Theodolite of 2" Accuracy. ("Triangulatsionnyy Teodolit 2" Tochnosti").
192	3	Picture of External View.
194	4	Astronomic Universal of 2" Accuracy. ("Astronomicheskiy Universal 2" Tochnosti").
194	4	Picture of External View.
195	5	Precision Level. ("Pretsizionnyy Nivelir").
195	5	Picture of External View.
196	6	Topographical Stereometer. ("Topograficheskiy Stereometr").
196	6	Picture of External View.
197	7	Four Pendulum Support. ("Chetyrekhmayatnikovyy Shtativ").
197	7	Picture of External View.
199	Table	Data on the quality of Limb Graduation of Theodolites of Several Types.
384		Picture: External View of the Comparator of the Jäderin Apparatus.
392		Picture: General View of the Gravimetric Variometer. (V Gravimetricheskoy Laboratorii. Rabota s Variometrom).

Source VII: Shershen', A.I., Aerofotos"yemka, Letnos"yemochnyy Protsess (Aerial Photography, Aerial-Surveying Process), Izdatel'stvo Geodezicheskoy i Kartograficheskoy Literatury, Moskva, 1949.

Text (Data) Page	Figure or Table No.	Information Available
23	13	Picture. External View of So-called "Nine-Objective Aerial Camera 'AD-1' and 'AD-2'" ("Devyatiob"yektivnyy Aerofotoapparat"). Designed by F. V. Drobyshev in 1932. The optical axes of the eight lateral lenses of this camera form 45° angles with the optical axis of the central lens. The objectives used are of Soviet manufacture with a focal length of 135 mm. and a negative size of 12 x 12 cm. The over-all angle of view of the outfit along the length and width of the course reached 140°. The distance between the aerial surveying routes with 40% overlapping exceeded the flight altitude by two times. After rectifying the oblique photographs into the projection of the plane one the over-all photograph of one exposure assumes the form of an octogon with the sides of a square inscribed in it equal to 50 cm. (See figures 14 and 14a). The camera is loaded with aerial film for 150 exposures. The winding of it and the setting into motion of the central shutters were accomplished by hand, by means of two hand wheels. The over-all weight of the camera was about 55 kg.

Text (Data) Page	Figure or Table No.	Information Available
26	15	Picture. External View of So-called "Wide-Angle Adapter for Aerial-Camera RMK C-3" ("Shirokopolosnaya Nasadka k Aerofotoapparatu RMK C-3").
27	16	Drawing Showing the Working Parts of the "Wide-Angle Adapter", the External View of Which is Shown in Fig. 15. In 1932, the Leningrad Scientific-Research Institute of Aerial Surveying (Leningradskiy Nauchno-issledovatel'skiy Institut Aeros"yemki) worked out an original optical attachment for a single-objective aerial camera, which made it possible to do plane-oblique photography without changing the position of the optical axis of the camera. This attachement, called by its designer Yu. K. Yutsevich "a wide-angle adapter", was placed in front of the objective of the usual camera and increased the field of view along the course up to 122°. A similar wide-angle adapter for aerial-camera RMK C-3 and its working principle are shown in figures 15 and 16."
31	22	Picture. External View of Aerial Camera ("Aerofotoapparat") "AFA-13". "The first Soviet automatic aerial-camera 'AFA-13', manufactured by the 'Geodeziya' plant, was equipped with a new high-quality aerial photography objective with the brand name 'Industar-13' with a focal length of 300 mm

Text (Data) Page	Figure or Table No.	Information Available
		and a relative aperture of f/4.5. 'AFA-13' (Fig. 22) was activated by an electric motor operating on direct current with a voltage of 12 volts. The cassette contained 150 negatives 18 x 18 cm. in size. The film was aligned by means of the creation of a vacuum by a special suction device. The apparatus was equipped with a between-the-lens shutter of the Jalousie type, with exposure speeds of from 1/75 to 1/200 sec. and was operated by means of an intervalometer with a diapason of intervals between exposures of from 5 to 60 sec. A signal light for verifying the action of the mechanism of the cassette and a counter of the number of aerial photographs made lightened the work. A second counter was included in the camera and its indications were shown on each picture. The aerial mount of the Cardan type had rubber shock absorbers. 'AFA-13' was intended for plane surveying for purposes of military reconnaissance. It replaced the 'Potte' apparatus which had formerly been used for that purpose."
33	23	Picture. External View of Aerial Camera (and Attachments) ("Aerofotoapparat") "MAFA-13". "Later the AFA-13 was modernized. It was equipped with a short-focus objective 'Russar-1', with a corresponding

Text (Data) Page	Figure or Table No.	Information Available
		alteration of the camera section. Other changes were also introduced into its design: the Jalousie shutter was replaced with a central shutter GOMZ, a liquid statoscope (of the D.I. Mendeleyev type) was used, the readings of which were indicated on each photo; the winding of the aerial film was improved by means of a supplementary negative system, etc. This apparatus under the name 'NAFA-13' (Fig. 23) was used in such a form in aerial (flying) survey work until additional improvements were made. At length the focal plane was moved out of the cassette into the camera and the GOMZ shutter was replaced by a central shutter of the 'CV-1' type, designed by the Soviet engineer Vertiporokh."
71	43	Drawing. Working Parts of a Two-Slit camera (Aerial Camera) of the "AShchAFA-2" Type. This type of two-slit camera is said to have "an important advantage over the one-slit apparatus. It makes it possible to photograph at the same time in two scales: in the larger scale -- with objective O_1 of the 'Plazmat' type, with k = 210 mm (1:n = 1:3.5, 2 = 600), through slit z_1, and in a smaller scale -- with a wide-angle objective O_2 of the 'Russar-2' type, through slit z_2." Use of aerial film of a width of 25 cm.

Text (Data) Page	Figure or Table No.	Information Available
135	71	Picture. External View of Range Finder "OPB-IM". Field of View of the order of 30°.
136	72	Drawing. Working Parts of the Range Finder "OPB-IM", the External View of Which is Shown in Fig. 71.
137	74	Drawing. Detail Drawing Showing Gauges and Scales of the Supporting Installation for the Range Finder "OPB-IM".